

Student Learning in the Metros

EI Working Paper Series – Issue 2

This working paper summarises a very interesting study conducted on over 30,000 students in India's leading schools in 2006. The results suggest that rote learning dominates learning even in our top schools.



We acknowledge the support of India Today magazine – many graphics used in this paper are from its November 2006 issue which featured this study as the cover story.

Educational Initiatives (EI) believes that significantly improved student learning can happen only through systematic research into learning which includes assessment, as well as areas like misconception research. This working paper series will share learnings from various past and present EI projects as well as path-breaking work in these areas elsewhere in the world. Please write to us at assessment@ei-india.com for questions or comments.



Educational Initiatives Pvt. Ltd.

www.ei-india.com

■ WHY THIS PROJECT HAS LARGER RELEVANCE

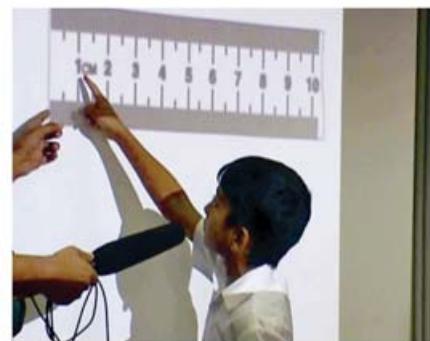
How well are students in our 'top' schools learning? In order to try and understand this, Educational Initiatives (EI) and Wipro Ltd. conducted a research study in the 5 metros – Mumbai, Kolkata, Chennai, Delhi and Bangalore in 2006.

These 'top' schools in our largest cities arguably represent the best education that is available in the country. These schools are likely to be the least constrained for different types of resources. Facilities like libraries, computers, playgrounds as well as access to resources (being located in the metros) are the best in the country. Partly for these reasons, these schools, in general, are the most coveted among parents and serve as role models to other schools. Often they are the thought leaders and their ideas and practices set the tone for others. It is therefore interesting to study how these 'role models' are faring.

In a limited sense, the purpose of this study was to understand how well students are learning in our 'top' schools. However the larger goal was to take a critical issue - the quality of student learning - and to try and gain insights about it based, not on opinion or 'experience', but on hard data.

■ SALIENT FEATURES OF THE STUDY

- **Expert Panel:** A group of eminent educationists and school principals formed an expert panel that oversaw and was consulted on various aspects of the study.
- **Selection of Top English Medium Schools:** The 'top' 40 schools were identified through a popular survey in each metro and then invited to participate in the study. In each metro, the survey covered about 200 people across 10 categories based on their profession and location in different geographical areas.
- **Specially Assembled Test Paper:** Students of classes 4, 6 and 8 from these schools were assessed through a test. The test consisted of objective, multiple-choice questions in English, Mathematics, and Science as well as a writing task. The questions were carefully selected from a pool of ASSET items which have already been extensively tested with thousands of students.
- **International Benchmarking:** Some questions from an international test, the TIMSS, were also included in this to provide a comparison with the performance of international students.
- **A Writing Task:** All students were administered a writing test, where they had to write a paragraph, story or report. This revealed insights about the writing competencies of students in these top schools.
- **Completely Invigilated Tests:** All the tests were invigilated by EI representatives, to ensure that the processes were standardised and possibilities of copying or collusion were minimised.
- **Background Questionnaires:** The test papers given to the students include 4 questions seeking information about student preferences and interests. School principals were also asked to fill a questionnaire seeking information about the school and its facilities.
- **Analysis:** Different types of analyses were carried out on the collected data to extract patterns in performances and to understand differences in learning levels across different groups. Advanced statistical methods and Item Response Theory were used to confirm patterns. Analysis was also done to check if copying had occurred.



Number of students schools who took the tests in the different cities

	Bangalore	Chennai	Delhi	Kolkata	Mumbai	Total
Schools Tested	26	37	24	23	32	142
Students tested (Main Study)	3286	4738	2814	2555	3845	17238
Students tested (Secondary Study)*	2996	4424	2610	2529	3889	16448

*The secondary study used common papers for classes 4, 6 and 8.

■ QUESTIONS THAT CHECK UNDERSTANDING

In this test, students were assessed on concepts that are part of their curriculum. However, the test used questions that checked for conceptual understanding, unlike the standard school tests which generally check rote learning. For example, the universalities of laws and rules is also often not understood by students. As shown in the example alongside.

"When light is reflected from a smooth surface, the angle of incidence must be equal to the angle of reflection."

Under which of the following situations is the above statement true?

- A. It is always true. (26%)
- B. It is true only if the surface is CONCAVE or PLANE. (17%)
- C. It is true only if the surface is made of GLASS (13%)
- D. It is true only if the surface is PLANE. (42%)

■ MAIN FINDINGS

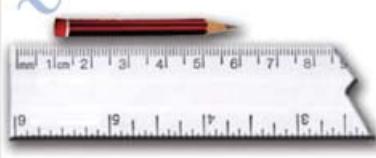
1. Students across classes answer rote-based or procedural questions relatively well. The flip side of this, however, is that students seem to rely on memory or learnt procedures to answer almost all questions, rather than trying to think through and solve the unfamiliar ones.
2. It appears that many practical competencies, important in real life, are not being developed very well. Students' performance on questions based on measurement, estimation, problem solving, general observation and day-to-day language use is not very good.
3. Instead of acquiring concepts, students seem to be learning to handle a limited number of question types. So when they come across a question similar to one they have 'learnt', they 'jump' to the most familiar answer they find!
4. Students are learning in 'compartments', i.e. they may be aware of two pieces of information, but often not know how they are related or how that relation works in a real life situation.
5. Apart from problems with learning strategies, a number of specific and clear 'common errors' exist in the different subjects. Since they are widespread, it should not be difficult for textbooks and teachers to specifically address these errors.
6. Some background information - like the average class size, the number of hours of instruction per week, the number of working days per week and whether the school has laboratories for English, Maths and Science - was sought from each participating school through a questionnaire developed for the purpose. Only a very weak negative correlation was observed with the class strength. No other factors correlated significantly with the average performance of the schools/classes.

■ SUBJECT-WISE FINDINGS - MATHS

- Analysis shows that conceptual understanding tends to be weak in certain topics like decimal fractions, concepts like perimeter and general number sense. Students do not seem to have developed a conceptual understanding of decimal fractions. Similarly, a common misconception is that multiplication must always yield a greater number than division or other operations. Students seem shaky with the concepts of area and perimeter. Even among the two, perimeter seems to be less understood.

MATHS

WHAT IS THE LENGTH OF THE PENCIL IN THE PICTURE?



A 4 cm **C** 6 cm
B 5 cm **D** 7 cm

CORRECT ANSWER IS OPTION 'B'

How they answered



Observation

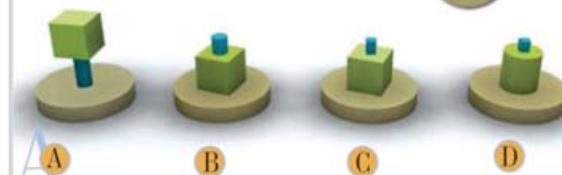
Class IV students know that readings have to be taken from the right side of the scale but not when the left end is not at zero. That this is not just an oversight is evident because the error is repeated in similar questions.

Graphics by ALANKAR

IDENTIFY THE CORRECT ARRANGEMENT

Three solids when arranged one on top of the other look like this from the top (see figure).

Which of these could be the arrangement?



CORRECT ANSWER IS OPTION 'B'

All questions © ASSET

How they answered

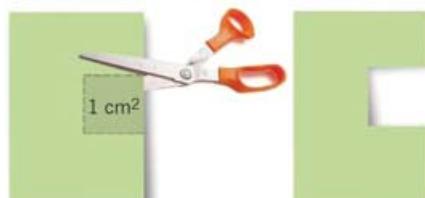


Observation
Class VI fared relatively well in a question needing visualisation even though this is not formally taught in schools.

Percentages in this graphic and others may not total 100 because of invalid or no responses

WHAT IS THE PERIMETER?

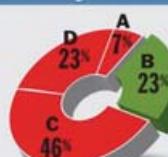
Nandita cut off a square of side 1 cm from a rectangular sheet as follows. What would be the change in perimeter as compared to the original paper?



A It would remain the same
B It would increase by 2 cm
C It would decrease by 2 cm
D It would decrease by 3 cm

CORRECT ANSWER IS OPTION 'B'

How they answered



Observation
Class VIII students seemed to think that cutting something off will mean the perimeter will reduce.

SUBJECT-WISE FINDINGS - ENGLISH

- A number of basic errors related to spellings and pronunciation were noticed in which students were asked to identify a word rhyming with 'dawned' in class 8. Similarly, students chose 'hear' (60%) rather than 'pear' (22%) when asked which word rhymes with 'hair'. They also felt that 'size' rhymes with 'seize', not 'flies'. It is clear that many students are choosing words that are spelt similarly, rather than rhyming words.
- Comprehension errors are common in cases where the answer does not appear explicitly in the text.

STUDENTS' ENGLISH WRITING SKILLS

In addition to the objective type items used in the main and secondary studies, a writing task - writing a paragraph, describing a picture/incident or writing a story - was also given to each student. About 32,000 student writing samples were thus obtained. A random sample of these were selected and analysed.

The analysis shows that although students' proficiency in English increases with class, even in class 8 about 80% of students are making mistakes in comprehension, grammar and syntax. It appears that for a large population of students language learning is mechanical, with students often failing to relate a writing task to its real life implications.

WHAT'S AMISS IN ENGLISH

Common errors that occur in student writing across classes IV, VI and VIII

SPELLING	GRAMMAR AND PUNCTUATION
4th carring for carrying gowing for going sum for some	<i>say the aunty, said you, asked that, he said his mother is been carrying, has went</i> Ignoring capitalisation of proper nouns Errors in sentence formation and punctuation
6th minites for minutes carring for carrying	<i>said you, not in the home</i> Improper use of capitals and apostrophe and erroneous sentence formation <i>has went, is been carrying, was come, calls to our house</i>
8th carring for carrying recieve for receive aunti/anti for aunty meat for meet greatful for grateful	<i>asked to me, rang of the phone, the Dipti Aunty</i> Ignoring capitalisation of proper nouns and unnecessary speech marks in written text <i>if you going to be delayed</i>

Once there lived a boy named Aditya. He was alone at his house. The telephone was ringing. Aditya picked up the phone and it was his mom's friend's phone. So then Aditya told his aunt that his mother had gone to pick some flowers for her friend Dipti Aunty who was in the hospital. Then Rama Aunty told Aditya that even she was going to see Dipti Aunty. She asked him to tell his mom to pick her up from the bookstore and she would bring some fruits and she also told Aditya her cell number.

This was the end of the story! (37 out of 81)

Some students wrote stories where they had to report a telephonic message.

ENGLISH

All questions © ASSET

CHOOSE THE SENTENCE WITH NO MISTAKES.

A The taj mahal is is agra
B The Taj Mahal is in agra
C The Taj mahal is in agra
D The Taj Mahal is in Agra

CORRECT ANSWER IS OPTION 'D'

How they answered



Observation

Grammar tends to be emphasized a lot in our system—one reason why 80 per cent students of class IV got this right.

WHY, ACCORDING TO THE PASSAGE, IS PHARAOH TUTANKHAMEN FAMOUS?

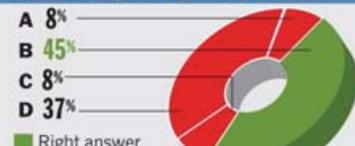


"Tutankhamen's tomb was forgotten until Howard Carter discovered it... (in) 1922... (The) treasures (in his tomb) made Tutankhamen perhaps the best known of the pharaohs..."

A He died under tragic conditions
B His tomb had many valuables
C The walls of his tomb were thick
D The tomb was discovered in 1922

CORRECT ANSWER IS OPTION 'B'

How they answered



Observation

None of the phrases in the question appear as they do in the passage—enough to confuse class VI students.

SUBJECT-WISE FINDINGS - SCIENCE

SCIENCE

WHAT IS THE CHEMICAL FORMULA OF PURE STEAM?



A (A) CO
 (B) H₂O
 (C) O₂
 (D) Pure steam does not have a chemical formula

CORRECT ANSWER IS OPTION 'B'

How they answered

A 4%
 B 37%
 C 6%
 D 51%

Observation

Class VIII students fail to make a two-step reasoning: that water is H₂O and it evaporates to form steam.

All questions © ASSET

THE EARTH'S ROTATION ON ITS AXIS IS THE REASON FOR...



A (A) the different seasons
 (B) longer days in summer
 (C) eclipses
 (D) day and night

CORRECT ANSWER IS OPTION 'D'

How they answered

A 17%
 B 8%
 C 7%
 D 66%



Observation

Class IV students fare well in this typically 'textbookish' question showing ease in handling rote problems—this is seen in other such questions as well across all grades and in all cities.

In Science, misconceptions or common errors were found. Some of these are:-

A. When asked the chemical formula for pure steam, 51% students answered that pure steam does not have a chemical formula, even though the 3 facts given below are known to the students by this stage:

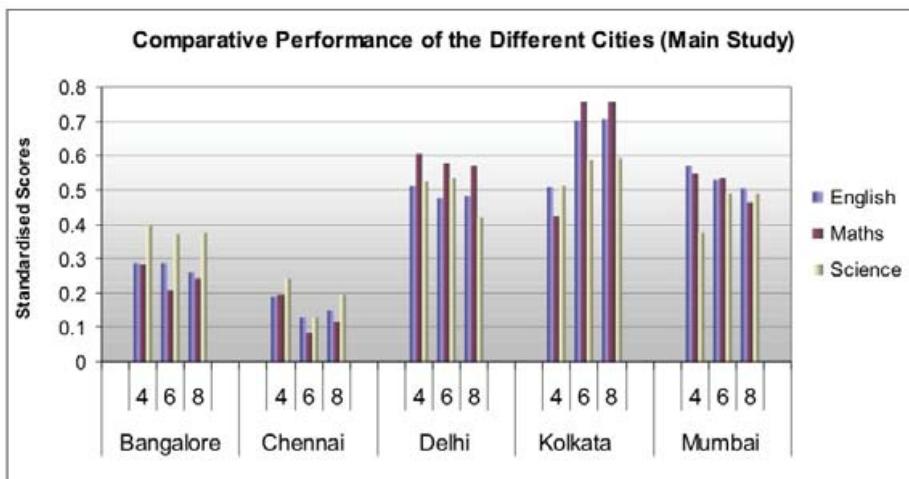
1. The chemical formula of water is H₂O.
2. Water changing to steam is a physical change
3. Chemical composition does not change in a physical change.

B. If one considers biologically, is Man an animal? A fly? The answer is yes, and it is discussed under classification of living things - an important topic. Yet 19% of class 8 students do not think that Man is an animal and 47% do not think flies are animals.

C. The height of the water collected (though not the volume) in any vessel of uniform cross-section in a rain will be the same - that is why rainfall is measured in cm. Yet, 74% of students in class 6 did not think so. This kind of question will be answered well if students are required to do simple experiments like collecting rain water and checking what the height of water collected depends on.

COMPARATIVE PERFORMANCE OF THE METROS

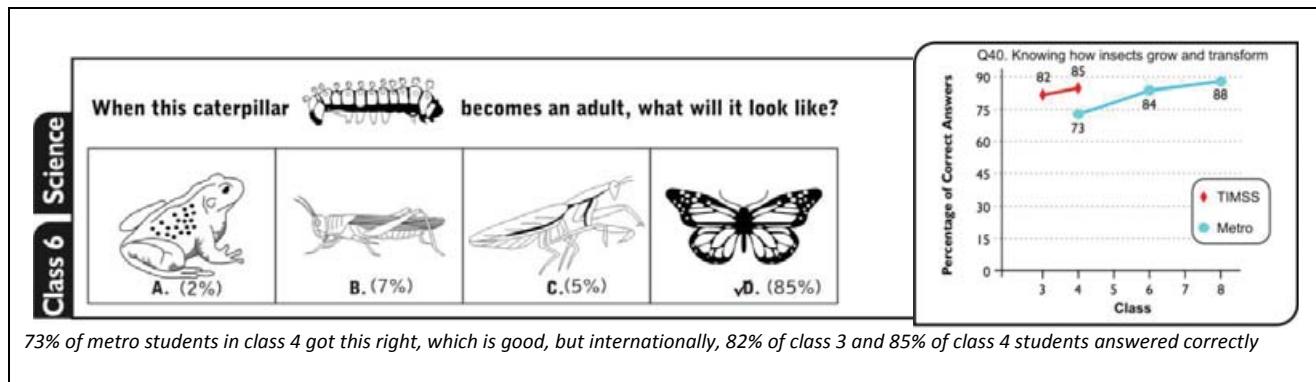
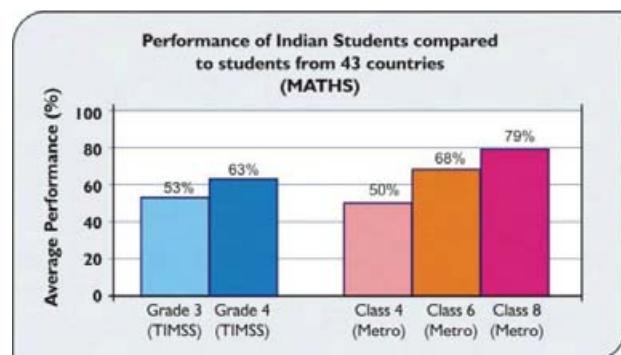
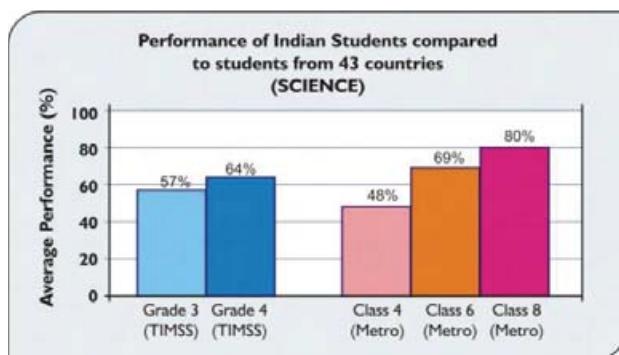
It may be expected that the 'top' schools of the 5 metros will NOT show any major difference in their overall performance. After all, many important factors are similar across the schools. These include factors like infrastructure, socio-economic background of the students, and teacher profile. But the data showed clear differences between the performances of schools in these metro cities. Top schools of Delhi, Mumbai and Kolkata performed significantly better than those of both Chennai and Bangalore. This result was cross checked in three different ways for robustness of the pattern found – performance in the Secondary Study, by removing outliers in the main study and checking if there is an effect due to some top schools refusing to participate in some cities. All 3 analyses showed the same trend, with Chennai and Bangalore performing lower than other cities. Please note that all this refers only to the performance of "top schools" – for example, no conclusion can be drawn about the comparative performance of government schools in these cities.



■ COMPARISON WITH INTERNATIONAL BENCHMARKS

How are the students in the 'top' schools of our metros performing compared to their peers in other countries? To find this out, some questions from Trends in International Mathematics and Science Study (TIMSS), an international assessment in which over 40 countries participated were included in the paper used for the secondary study. Since the performance of students internationally on these questions was known, a comparative picture could be obtained.

The findings are, to say the least, quite worrying. Students from the 'top' schools of our metros are performing below average international levels. The performance of the class 4 students is significantly lower than the international average in each one of the 11 questions included from TIMSS. More strikingly, students of a higher class (class 6) performed only marginally better than the international average for class 4 students. As seen in the graph, the trend is similar in both Maths and Science. It is worth remembering that the data being compared is of Indian students in 'top' schools (by popular perception) and the average students of other countries.



■ OVERALL RECOMMENDATIONS

This section contains some specific recommendations mostly at a systemic level. Some are easier to implement than others, but all of them, we believe, would help us move closer to the goal of improved student learning.

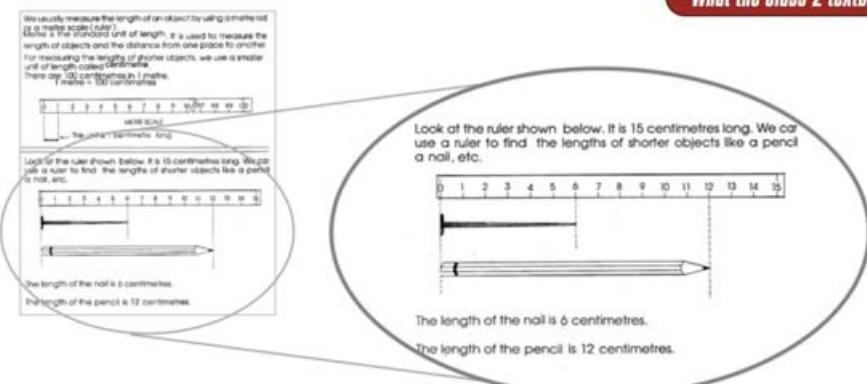
1. Stereotypical misconceptions / mistakes in comprehension exist among students – many of which are highlighted in this report. When updating textbooks and during teacher training programmes, such findings should be taken into account so that the incidence of such misconceptions may reduce.
2. A debate needs to be initiated on the importance and role of learning with understanding and the problems with rote learning.
3. The nature of questions in the Board Exams should change with more questions that test learning with understanding and fewer rote / recall questions. This will have a downstream effect on the nature of school test questions and classroom questions.
4. Teacher training that impacts the teaching methodology to make it more understanding rather than rote-focused will be a critical enabler.
5. The practice of Boards to give students very high marks - close to 100% in most subjects - has many negative effects. Apart from creating pressure (because a single mark matters so much more in a high scoring situation), inflated scores are often taken as indicators of thorough learning. Boards should start awarding students a percentile score in every paper. This is neither difficult to do, nor is it objectionable in any way.
6. India should participate in international benchmarking assessments like the TIMSS which test students on how well they can apply the learnt competencies/concepts. This will help the country benchmark student performance with the rest of the world and become the basis for improvement. Benchmarking studies like the TIMSS can be conducted within India also.

■ DISCUSSION – ARE STUDENTS TAUGHT THE CONCEPTS THAT WERE TESTED

Measuring length of objects with a ruler is a hands on skill.

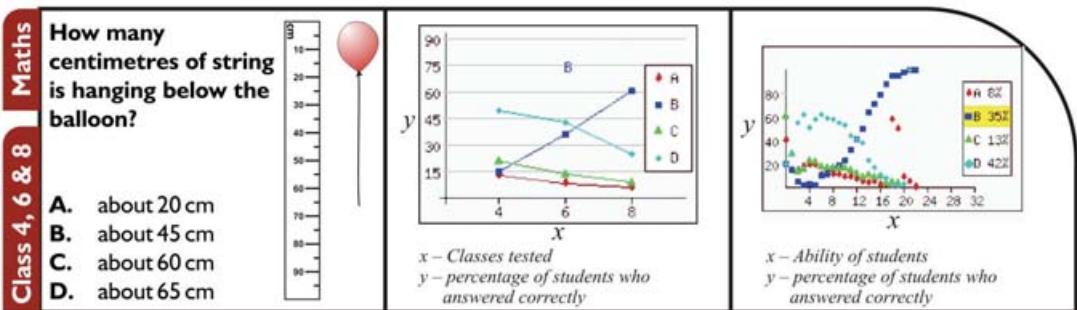
The NCERT mathematics textbook of class 2 carefully shows how the length of an object can be measured with a scale. However, we see that a lot of students having trouble measuring the length of an object correctly even in classes 4 or 6.

What the class 2 textbook says...



Source: NCERT, class 2 page 178, 'Measures of Length'

...various questions involving practical measurement. Here is one example:



It looks like a majority of children (49% in class 4, 42% in class 6, 25% in class 8) are learning measurement mechanically and choose option D. When measurement does not start from zero, as in this question, they do not see a need to subtract the starting point from the final one (in our case, $65 - 20 = 45$ cm).

■ REFLECTIONS

This study shows surprising results that even in the 'top' schools, a significant fraction of middle school students have not mastered primary school competencies; and that significant differences exist in the learning levels in various Indian cities. We would like to emphasize that the purpose of this study is not to sensationalise these gaps or even to identify the so-called 'top cities' or 'top schools' - in fact, these aspects have been consciously downplayed in the report. The question of interest is how can we discover underlying, non-apparent patterns and use that learning to improve the system? That is the purpose of this study.

We would like to believe that studies like this help us identify problems and thus give us a chance to move onto the cycle of problem discovery, cause identification, solution implementation and feedback (which may lead to a deeper level of problem identification) and thus create a positive spiral towards improvement.

■ BIBLIOGRAPHY AND REFERENCES

1. Adams, R.J., & Khoo, S. (1993), "Quest: The Interactive Test Analysis System" Melbourne: Australian Council for Education Research.
2. Currie, T. (1998), "Early Test Scores, Socioeconomic Status and Future Outcomes".
3. NFER (1997). "Trends in Standards in Literacy and Numeracy in the United Kingdom".
4. UNICEF (2000), "Defining Quality in Education", Working Paper Series.
5. <http://timss.bc.edu/timss2003i/released.html>
6. <http://timss.bc.edu/timss1995i/items.html>

■ ABOUT EI

Educational Initiatives (EI), the makers of ASSET and Wipro Applying Thought in Schools jointly conducted a national level research study to understand how well children are learning in the top schools of our country. Over 32,000 students from 142 leading schools of five metros - Mumbai, Kolkata, Chennai, Delhi and Bangalore participated in the tests conducted between February and April 2006. *The November 27th issue of India Today carried a cover story highlighting some of the main findings of the study.* The full report and the detailed questions-wise analysis can be downloaded from the following link <http://www.ei-india.com/whats-wrong-with-our-teaching/>



We are an educational research organization that focuses on learning research through assessments. EI has been started by a group of IIM Ahmedabad alumni with first-hand experience of setting up and running educational institutions. It has been formed with a mission to work towards qualitative improvement in India's educational system and our vision is "A world where children everywhere are 'Learning with Understanding'".

PROJECTS OF EI:

Andhra Pradesh Randomised Evaluation Study (2004 onwards): Done in partnership with Harvard University, Azim Premji Foundation, World Bank and the Government of Andhra Pradesh, this is a longitudinal study across 8-9 years and covers currently 100,000 elementary school kids and measures the impact of various inputs (eg., block grants, additional teachers) with outcome-based teacher incentives.

Assessment of Student Learning in Sarva Shiksha Abhiyan – RGSM, Chhattisgarh (2008 onwards): The test was developed in Hindi and administered to approximately 3 lakh students in about 1900 schools in 16 districts in Chhattisgarh states. The tests have already been conducted for students of class 3 to 8 for Language and Maths and the report is in final stages.

Municipal School Benchmarking Study (2004-2007): Supported by ICICI Bank, this study assessed learning in 35,000 municipal school students from class 2, 4 and 6 across the 6 biggest towns in each of the states - Gujarat, Andhra Pradesh, Rajasthan, Chhattisgarh and Uttarakhand.

UNICEF Learning Assessment Study for Quality Education (2005-2006): assessed mathematics and language acquisition among primary school children in the UNICEF quality package schools in 13 states of India. The tests were standardised across 9 languages and involved very intricate development cycle involving language experts from all over India.

Teacher Needs Assessment (2008 onwards): is a census study that has been initiated by the Royal Education Council, Government of Bhutan. In this project all teachers of Bhutan are assessed for their general ability, competence in subject knowledge and pedagogical practices.

Student Learning Study (2008-2009): Supported by Google Inc., this study is currently ongoing and assesses student learning in 21 states of India. Nearly 190000 students in classes 4, 6 and 8 are tested for learning in Language and Maths in rural and urban govt. schools.

EI'S PRODUCTS AND LEARNING SOLUTIONS:

ASSET: is an objective-type, multiple-choice test for students of Classes 3 to 12. It is a scientifically designed, skill based assessment developed in India for Indian schools. It assesses students' level of proficiency in the skills and concepts underlying the school syllabus and provides them feedback about their strengths and weaknesses. Know more about ASSET at www.ei-india.com

Mindspark: is a computer based self-learning programme that helps the child improve his/her skills. It allows each student to follow a learning path that is based on his need. Mindspark is currently available for Maths for classes 2-10 in English version. Mindspark can be accessed at www.mindspark.in

Rural Mindspark: Hindi version is currently available on demand for some Maths modules. Contact EI to know more about other language versions and modules.

Some Partners / Clients

Google Inc. Rajiv Gandhi Shiksha Mission, Chhattisgarh WIPRO Applying Thought	Government of Andhra Pradesh Royal Government of Bhutan World Bank	Michael & Susan Dell Foundation Suzlon Foundation UNICEF, India
---	--	---

CONTACT DETAILS: Educational Initiatives Pvt. Ltd

Head Office Ahmedabad	Bangalore Office	Delhi Office	Hyderabad Office	Mumbai Office
613-615 JB Towers, Opp. Doordarshan Tower, Drive-in Road, Ahmedabad 380054, INDIA Tel: 079 – 40269696, 40269625 Fax: 079-26841400	No.97, 2nd Floor, Robertson Road, Frazer Town, Bangalore-560005 INDIA Tel: 080 – 41657715, 64567049, 41237162	3rd Floor, Lakshey Deep Plaza, A-252A, Sant Nagar, East of Kailash, New Delhi-110065 INDIA Tel: 011-26462264, 40584952	Flat No 401/A, Shri S.K.Vihar, H.No:3-4-578/1, Beside Sri Chaitanya Colelge, Narayanaguda, Hyderabad-500029 Tel: 040 – 32419534	Row House Number 1, Sea Coast 2, (Near Cidco Guest House), Kille Gaonthan, Belapur, Navi Mumbai-400614 INDIA Tel: 022 - 32686329, 27561430

e-mail us at: assessment@ei-india.com Website: www.ei-india.com

November 2009